82895
S/120/60/000/02/027/052
E032/E314

A Mass Spectrometer with a High-vacuum Mass Analyzer

resolution approximately 100 - 150, mass range 1 - 200, amplifier sensitivity $1.10^{-15}$ A, minimum measurable partial pressure of a component $10^{-9}$ - $10^{-10}$ mm Hg, residual gas pressure in the analyzer $\leqslant 10^{-8}$ mm Hg, time of recording of the mass spectrum (1 - 100 mass units) 10 - 12 min. A typical mass spectrum obtained is shown in Figure 2. A block diagram of the apparatus is shown in Figure 1. The inner surfaces of the various tubes are covered by a layer of SnO, which improves the vacuum in the analyzer. Outgassing is carried out by external heating by firing a getter and by switching-on an ionisation monometer (Bayard and Alpert - Ref 8). There are 2 figures and 11 references, 9 of which are Soviet, 1 English and 1 German.

ASSOCIATION: Kiyevskiy gosudarstvennyy universitet (Kiyev State University)

SUBMITTED: March 16, 1959

Card 2/2

L 24206-65 EWT(l)/EWO(k)/EWT(m)/EPA(sp)-2/EPF(c)/EPF(n)-2/EPA(w)-2/EWP(j)/T/EWA Pz-6/Pc-4/Pab-10/Pr-4/Pi-4/IJP(c)/RWH/AT/RM (c)/EPA(w)-2/EWP(j)/T/EWA Pc-4/

ACCESSION NR: AP5002906 Pz-6/Pab-10/ S/0109/65/010/001/0116/0123 Pr-4/Pi-4

IJP(c) RWH/AT/RM

AUTHOR: Pikus, G. Ya.; Shnyukov, V. F.

B

TITLE: Effect of an admixture of nickel in the oxide layer upon the physical and chemical properties of an oxide-coated cathode (Effect of Ni admixture upon the interaction between an oxide-coated cathode and carbon monoxide)

SOURCE: Radiotekhnika i elektronika, v. 10, no. 1, 1965, 116-123

TOPIC TAGS: oxide coated cathode, cathode emission, cathode activation, cathode poisoning

ABSTRACT: The results are reported of an experimental investigation of oxide-coated Ni and Pt cathodes tested in sealed laboratory tubes equipped with a CO in-leaking device and titanium sorption pump; the time of building CO pressure to a desirable level was 20—30 sec; exhaustion down to $(2-3) \times 10^{-8}$ torr took 15—20 sec. It was found that the CO effect depends on the cathode activity, its

Card 1/2

L 24206-65
ACCESSION NR: AP5002906

temperature, and CO pressure and may bring about either activation or poisoning of the cathode; while the Pt-base cathode is rapidly and reversibly activated by admission of CO, the Ni-base cathode is activated slowly, may become temporarily poisoned, and does not exhibit complete reversibility. Equilibrium CO pressures of $(1-7) \times 10^{-7}$ torr were used in the tests. The results are explained by a catalytic reaction of the oxidation of CO into $CO_2$, the role of catalyst being played by both the oxide layer and the Ni additive. Orig. art. has: 6 figures. [03]

ASSOCIATION: Kiyevskiy gosudarstvennyy universitet im. T. G. Shevchenko (Kiev State University)

SUBMITTED: 23Sep63 ENCL: 00 SUB CODE: EC

NO REF SOV: 009 OTHER: 004 ATD PRESS: 3177

Card 2/2

L 24205-65 EWG(j)/EWT(l)/EWG(k)/EWT(m)/EPA(sp)-2/EPF(c)/EPF(n)-2/EPR/EPA(w)-2/ T/EWP(t)/EWA/EWP(b) Pz-6/Pab-10/Pr-4/Ps-4/Pn-4 IJP(c) RWH/JD/JW/HW/AT

ACCESSION NR: AP5002907 S/0109/65/010/001/0124/0132

AUTHOR: Pikus, G. Ya.; Shnyukov, V. F.

TITLE: Effect of an admixture of nickel in the oxide layer upon the physical and chemical properties of an oxide-coated cathode (Vaporization and emission characteristics of oxide-coated cathodes containing an Ni admixture in their oxide layer)

SOURCE: Radiotekhnika i elektronika, v. 10, no. 1, 1965, 124-132

TOPIC TAGS: oxide coated cathode, cathode emission

ABSTRACT: The results are reported of an experimental investigation of the vaporization, gassing, and emission characteristics of an oxide-coated cathode containing a specially introduced admixture of Ni. Three-carbonate (49:44:7) Pt-base cathodes were tested. With a Ni-free cathode, the principal vaporization product was found to be BaO; metallic Sr vaporized at a rate of 1% of that of BaO.

Cord 1/2

L 24205-65
ACCESSION NR: AP5002907 2

With a Ni-bearing cathode, BaO remained the principal product, and Ni vaporized at a rate of 2—3% of BaO vaporization; appreciable quantities of metallic Ba were detected; the rate of vaporization of BaO was considerably lower than that in the case of the Ni-free cathode. Increasing the cathode temperature from 1200K to 1400K resulted in a rapid decrease in the BaO rate of vaporization back to its initial value. The Ni-bearing cathodes exhibited a trend toward activation during 200 hr, after which their emission reached 5—7 amp/cm$^2$ (current pulses, at 1200K) while Ni-free cathodes had no such trend. The cathodes with 3—5% Ni were better activated than those with 7—9% Ni. The explanation offered for the above phenomena is adsorption of colloidal Ba particles by colloidal Ni particles. Orig. art. has: 7 figures, 2 formulas, and 1 table. 27 [03]

ASSOCIATION: Kiyevskiy gosudarstvennyy universitet im. T. G. Shevchenko (Kiev State University)

SUBMITTED: 23Sep63 ENCL: 00 SUB CODE: EC

NO REF SOV: 009 OTHER: 006 ATD PRESS: 3177

Card 2/2

5A

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537.311.33 537.32

5117. **On the thermoelectric properties of semi-conductors.** G. E. PIKUS. Note in *Zh. Eksper. Teor. Fiz.*, 21, 852-3 (*No.* 7, 1951) *In Russian.*

It is shown that the "Gurevich effect" [an additional thermo e.m.f. associated with temperature gradients] is negligible for semiconductors. W. J. SWIATECKI

PIKUS, G. YE

USSR/Physics - Semiconductors Nov 51

"Influence of Surface Levels on Chemical Potential and Work Function of Semiconductors," G. Ye. Pikus, Leningrad Polytech Inst

"Zhur Eksper i Teoret Fiz" Vol XXI, No 11, pp 1227-1238

Discusses effect of superficial levels on state of chem potential, output of work, and its variation in elec fields, on elec cond of semiconductors and on stopping layer in case of contact of semiconductor and metal. Obtained results show new possibilities of exptl investigation of superficial states. Acknowledges assistance of Prof A. I. Anselm. Submitted 10 Jan 51.

204T93

PIKUS, G. YE.

USSR/Physics - Electron Optics Mar 52

"Influence of Surface of Electrons State on Optical Properties of Semiconductors and Dielectrics," G. Ye. Pikus, Leningrad Polytech Inst

"Zhur Eksper i Teoret Fiz" Vol XXII, No 3, pp 331-338

Studies reflection of electromagnetic waves from plane surface in presence of surface cond produced by electrons of superficial zone. Shows that at angles of nearly 90° incidence reflection increases with increasing incident angle, if vector E is

215T75

parallel to surface; and decreases, if E is nearly perpendicular. This particular angular relation of reflection produced by electrons of superficial zone is different from reflections produced by other factors. Indebted to A. I. Ansel'm and Ye. F. Gross. Received 18 Jun 51.

215T75

Pikus, G. Ye.

USSR/Physics - Thermodynamics

Card 1/1 : Pub. 153-14/2. FD-60.

Author : Pikus, G. Ye.

Title : The solution to one type of nonstationary thermal problems

Periodical : Zhur. tekh. fiz., 24, 287-291, Feb 1954

Abstract : Discusses a method for solving the thermal problem in the case of heat exchange of a body with a medium of constant temperature which, under certain initial conditions allows one to reduce the solution of a multidimensional problem to the solution of a one-dimensional problem. references.

Institution :

Submitted : May 17, 1953

USSR/Physics - Photoeffect

Card 1/1 : Pub. 146-14/20 FD-1491

Author : Pikus, G. Ye.

Title : Photoeffect from surface levels

Periodical : Zhur. eksp. i teor. fiz., 27, 369-381, Sep 1954

Abstract : The external photoeffect produced by knocking out electrons from the surface zone of a semiconductor or dielectric is analyzed. It is shown that in the case of full or half-filled surface zone such photo-current forms an essential part of the whole photo-current from the semiconductor. Indebted to Prof A. I. Anselm. Eight references, including 2 foreign.

Institution :

Submitted : April 29, 1953

PIK'S, G. Ye.

"The Influence of Surface States of Electrons on the Optical and Electrical Properties of Semiconductors and Dielectrics." Cand Phys-Math Sci, Leningrad Order of Lenin State U imeni A. A. Zhdanov, Leningrad, 1955. (KL, No 11, Mar 55)

SO: Sum. No. , 2 Sep 55--Survey of Scientific and Technical Dissertations Defended at USSR Higher Educational Institutions (15)

USSR/Physics - Semiconductors conference PIKUS - Ye FD - 3164

Card 1/4 Pub. 153 - 20/26

Author : Pikus, G. Ye.; Firsov, Yu. A.

Title : Conference on the theory of semiconductors

Periodical : Zhur. tekh. fiz., 25, No 13 (November), 1955, 2381-2384

Abstract : A conference on the theory of semiconductors, called by the Commission on Semiconductors in the Presidum of the Academy of Sciences USSR, was held in Leningrad from 4 to 8 February 1955. Participants were leading physicists and theoreticians of Moscow, Leningrad, Kiev, Sverdlovsk, Khar'kov, Chernovits and other cities, who are working the field of solid state physics. Academician A. F. Ioffe opened the conference with a report noting that a number of experimental facts contradict theory (e.g. various values of effective masses in their determination by different methods, anomalous temperature behavior of mobility and thermo-emf, etc.), that existing theory is actually inapplicable to many semiconductors (e.g. zone theory issuing from distant ordering is inapplicable to fluid and amorphous semiconductors, whose electrical properties do not differ from those of crystal semiconductors), that the existing theory of mobility is inapplicable to semiconductors with small mobility in which the free path length calculated from experimental data is less than the wavelength of electron and often even less than the lattice period, and that relations have yet to be found between the various properties of semiconductors (electric, magnetic, thermal, mechanical) and atomic characteristics. The conference

Card 2/4 Pub. 153 - 20/26 FD-3164

heard and discussed 12 reports on the following 9 most important divisions of semiconductor theory. I. Theory of polarons: S. I. Pekar, "Present status of semiconductor theory" (to be published in next issue). M. F. Deygen, "Theory of optical, magnetic and electric properties of metal-ammoniacal solutions." II. Polyelectron theory of semiconductors: S. V. Vonsovskiy, "Certain problems of the polyelectron quantum-mechanical theory of semiconductors" (to be published in ZhTF). Ye. P. Agafonova, "Accelerating action of external electric field on a system of interacting electrons in a crystal lattice" (she showed that in the polar model the accelerating action of field on a system in nonpolar state is practically absent in spite of nonzero probability of polarization of the system, i.e. in spite of probable formation of pairs and holes by the field; and that if the system has a finite number of pairs and holes then consideration of thermal motion of lattice gives an expression for electrical conductivity in weak field like that in the monoelectron theory). V. L. Bonch-Bruyevich, "Zone scheme of homeopolar crystal and oscillations of the crystal lattice." III. Magnetic properties of semiconductors: A. G. Samoylovich and L. L. Korenblit, "Certain problems of the theory of magnetism of semiconductors." IV. Theory of excitons: A. I. Ansel'm and Yu. A. Firsov, "Length of free flight path of nonlocalized exciton in atomic and ionic crystals." V. Theory of mobility thermal and galvanomagnetic effects: T. A. Kontorova, "Theory of mobility of current carriers in atomic semiconductors." VI. Theory of fluid and amorphous semiconductors: A. I. Gubanov, "Zone theory of fluidity for close ordering" (the author solved the one-dimensional problem earlier, in ZhETF, 26 (2), 139, 1954). VII. Theory of radiatorless transitions: M. A. Krivoglaz, "Theory of thermal transitions." VIII. Theory of rectification: K. B. Tolpygo, "Distribution of concentrations of carriers and ratio of electron and hole current." IX. Catalytic action of semiconductors: F. F. Vol'kenshteyn, "Mechanism of catalytic action of semiconductors" (the author expresses the assumption that electrons and holes on the surface of a semiconductor can play the role of free valences, and that the atoms and molecules adsorbed on the surface can capture these electrons).

In his concluding speech of the conference A. I. Ansel'm noted the following principal directions of the future development of solid-state theory: polyelectron theory of the solid state; application of general methods of quantum theory of the field to the problem of interaction of electrons with lattice oscillations; electrical and magnetic properties of crystals (theory of dielectric constant, diamagnetism, paramagnetism, and ferromagnetism of crystals); energy spectrum and mobility of current carriers in amorphous and fluid media; kinetic processes in semiconductors and metals (electrical conductivity, galvanomagnetic and thermomagnetic effects, influence of strong fields); theory of ion crystals (polar theory); theory of kinetic processes (electrical conductivity, galvanomagnetic and thermomagnetic effects) in semiconductors with small mobility where the concept of free path length loses sense; optical properties of electron crystals (internal photoeffect, absorption spectra, theory of the exciton); dynamics of crystal lattice (oscillation spectra, heat capacity, heat conductivity); phase transitions in crystal lattices, the theory of defects and impurities in crystals; nonstationary processes in a semiconductor (variable external fields), radiospectroscopy of solids, and cyclotron effect: theory of rectification and

Card 4/4 Pub. 153 - 20/26 FD - 3134

amplification in semiconductors, and theory of semiconductor devices; the electronics of thermoelectronic emission, secondary electron emission, self-electron emission, external photoeffect of interaction of ions with the surface of the solid; theory of catalytic action of semiconductors.

Submitted : April 4, 1955

PIKUS G.E.

Ion separation according to mobility. S. E. Bresler and G. E. Pikus. *Soviet Phys. Tech. Phys.* 1, 102-18(1956)(English translation).—See *C.A.* 50, 10559c. B. M. R.

Pikus, G. Ya.

6
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1-3km

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2

802. APPLICATION OF THE MASS SPECTROMETER FOR THE STUDY OF THE PROCESS OF ACTIVATION OF AN OXIDE CATHODE. N.D. Morgulis and G.Ya. Pikus. Zh. tekh. Fiz., Vol. 26, No. 6, 1174-6 (1956). In Russian.

The mass spectrometer system used had a sectorial 60° wide magnetic field and a glass tube, the degree of mass resolution was $\Delta m/m \approx 0.01$. First results show that the mass spectrometer method of analysis of the liberation of gas from an oxide cathode gives a number of valuable data.

Z.F. Wojnar

pmt

P, k'a , ( 1 a

G-3

Category USSR/Electricity - Semiconductors

Abs Jour : Ref Zhur - Fizika, No 2, 1957, No 4171

Author : Pikus, G.Ye.

Title : Thermal and Glavanomagnetic Effects in Semiconductors when Calculating the Variation of the Carrier Concentration. I. Thermal-and Galvanometric Effects

Orig Pub : Zh. tekhn. fiziki, 1956, 26, No 1, 22-35

Abstract : Discussion of the basic thermal and galvanomagnetic effects in semiconductors with current carriers of two polarities. The deviations from the equilibrium concentration of carriers are calculated for the case of weak fields, when the excess concentration is small compared with the equilibrium concentration of the carriers.

Card : 1/1

P... G. Ye

G-3

Category : USSR/Electricity - Semiconductors

Abs Jour : Ref Zhur - Fizika, No 2, 1957, No 4172

Author : Pikus, G.Ye

Title : Thermal and Galvanomagnetic Effects in Semiconductors When Calculating the Change in Concentration of Current Carriers. II. Galvanomagnetic Effects in Strong Fields. Electron and Exciton Thermal Conductivity

Orig Pub : Zh tekhn. fiziki, 1956, 26, No 1, 36-50

Abstract : The results of the preceding work (Abstract 4171) are generalized to the case of a strong electric field and for the limiting (weak and strong) magnetic fields. It is calculated, that in the strong fields the concentration of the pairs can differ considerably from the equilibrium concentration. The author calculates also the electron and excition heat conductivity of the semiconductor with allowance for deviations from the equilibrium concentration.

Card : 1/1

D-8

Category : USSR/Atomic and Molecular Physics - Liquids

Abs Jour : Ref Zhur - Fizika, No 1, 1957 No 970

Author : Bresler, S.Ye., Pikus, G.Ye.

Title : On the Separation of Ions by Their Mobilities.

Orig Pub : Zh. tekhn. fiziki, 1956, 26, No 1, 109-125

Abstract : Development of a phenomonological theory of the separation of ions by their mobilities, using as an example the separation of isotopes of liquid metal by electrolysis. Expressions are derived for the stationary and non-stationary distributions of the concentration of the isotopes and for the amount of isotope concentrated at the edge of the tube (for the stationary cases). The laws derived are applied to the analysis of the experimental data on the separation of Hg and Ga and to the calculation of the differences in the mobilities of the isotopes of these elements.

Card : 1/1

PIKUS, G.E.

Influence of surface recombination on the efficiency of a photocell with a p-n transition region. G. L. Bir and G. E. Pikus (Inst. Semiconductors, Acad. Sci. U.S.S.R., Leningrad). *Soviet Phys. Tech. Phys.* 2, 419-23(1957); *Zhur. Tekh. Fiz.* 27, 467-79; cf. Cummerow, *C.A.* 48, 9304i.—The voltage-current characteristics and the efficiencies of photocells contg. p-type and n-type regions sepd. by p-n junctions are calcd. Three types of losses are identified: incomplete absorption of incident light; recombination losses at the surface and in the vol.; "potential" losses at the barrier. Conditions that minimize these losses are described.

James H. Pannell

Pikus, G.E.

PA 2552

AUTHOR: PIKUS, G.E.

TITLE: Thermal- and Galvanomagnetic Effects in Semiconductors under Consideration of the Modification of the Concentration of Current Carriers. (Termo- i galvanomagnitnyye effekty v poluprovodnikakh pri uchete izmeneniya kontsentratsii nositeley toka, Russian)

PERIODICAL: Izvestiia Akad.Nauk SSSR, Otdel.Tekhn., 1957, Vol 21, Nr 1, pp 103-103 (U.S.S.R.)
Received: 4 / 1957 Reviewed: 5 / 1957

ABSTRACT: The following is a short extract from the contents of the lecture. (The detailed article was published in Zhurnal Eksperm. i Teoret. Fiziki, 1956, 26, 22, 36).
This work investigates the thermal- and galvanomagnetic effects of semiconductors with both signs of the current carriers. The modification of the concentration of electron-hole couples in weak fields (where the concentration of the couples differs little from the concentration of equilibrium) and in strong magnetic fields is investigated. In strong fields $uH/C \gg 1$ (u - mobility, H - field strength of the magnetic field), applies.
The problem of the influence exercised by deviation from equilibrium concentration on thermal conductivity resulting from electrons or exitons is investigated.

Card 1/2

PA - 2352

Thermal- and Galvanomagnetic Effects in Semiconductors under Consideration of the Modification of the Concentration of Current Carriers.

The above is a translation of this short report. (No illustrations).

ASSOCIATION: Not given
PRESENTED BY:
SUBMITTED:
AVAILABLE: Library of Congress

Card 2/2

CARD 1 / 2 PA - 1992

SUBJECT USSR / PHYSICS
AUTHOR ŽUZE,V.P., PIKUS,G.E., SOROKIN,O.V.
TITLE On the Problem of the Influence exercised by an Exterior Electrostatic Field on the Velocity of Surface Recombination in Germanium.
PERIODICAL Žurn.techn.fis, 27, fasc.1, 23-29 (1957)
Issued: 2 / 1957

Experimental method and results: The velocity of surface recombination was measured by the methods developed by O.V.SOROKIN, Zurn.techn.fis.26,11 (1956). On this occasion the effective diffusion lengths $L_a$ were experimentally determined, and from the values found in this way the velocities of surface recombination were computed. Investigations were carried out with rectangular plates made of monocrystalline n- and p-germanium. The upper boundary surface of the sample served for the mounting of metal probes: phosphorus bronze for n-germanium and tungsten for p-germanium. On the upper boundary surface of the sample a rectilinear stripe of ~ o,005 cm width, which was vertical to the longitudinal axis of the sample, was illuminated. A mica plate which was coated with silver on one side and had a thickness of from 0,0022 - 0,0030 cm was pressed or pasted on to the lower boundary surface. An electric voltage of up to 6 kV was applied to this silver coating. The block scheme of the measuring device is shown in form of a drawing.
A diagram illustrates the typical curve which is obtained on the screen of the oscillograph by bringing a probe into contact with the sample. When applying an exterior electric field to the sample the curve partly changed its shape,

Pikus, G.E.

4

L11640* (Russian.) Influence of Surface Recombination on the Efficiency of a Photoelectric Cell With a P-N Transition. Vliianie poverkhnostnoi rekombinatsii na koeffitsient poleznogo deistviia fotoelementa i *p-n*-perekhodom. G. L. Bir and G. E. Pikus. *Zhurnal Tekhnicheskoi Fiziki*, v. 27, Mar. 1957, ~~p. 467-472.~~

Determines the voltampere rating, and the efficiency of a photocell with p-n transition under consideration of the surface recombination. Conditions of minimum loss are shown.

aarf

57-6-3/36

AUTHOR ZHUZE, V.P., PIKUS, G.Ye., SOROKIN, O.V.

TITLE The Determination of the Surface Recombination Rate by Means of the Change of Semiconductor Resistance in the Magnetic Field. (Metod izmereniya skorosti poverkhnostnoy rekombinatsii po izmeneniyu soprotivleniya poluprovodnika v magnitnom pole -Russian)

PERIODICAL Zhurnal Tekh .Fiz., 1957, Vol 27, Nr 6, pp 1167-1173 (U.S.S.R.)

ABSTRACT A new method for the measurement of the velocity of surface recombination is described. It is based on the dependence of the resistance of a semiconductor sample in a magnetic field on the recombination velocity on its surfaces. The results of experimental chekings of this method are given. They agree well with theoretical predictions; i.e. they fully prove the theoretical final conclusions mentioned in the work of one of the authors (G.Ye. Pikus, T, 1956, Vol 26, pages 22-50) with regard to the dependence of the semiconductor-resistance in the magnetic field on the velocities of the surface-recombinations, the voltage and the frequency of the electric field, as well as on the voltage of the magnetic field. The method presented can be used for the investigation of the influence of an exterior electrostatic field and of the outer medium on the velocity of surface recombination. At present such experiments are carried out and will be published later in various works.

(1 table, 6 illustrations and 3 Slavic references).

Card 1/2

57-27-7-32/40

AUTHOR: Pikus. G. Ye.

TITLE: Hole Dispersion in Germanium and Silicon (Rasseyaniye dyrok v germanii i kremnii).

PERIODICAL: Zhurnal Tekhnicheskoy Fiziki, 1957, Vol. 27, Nr 7, pp. 1606-1609 (USSR)

ABSTRACT: A calculation of the matrix-elements in lattice-vibration-dispersions was performed for the case that the hole remains in the same zone and for the case that the hole goes over into another zone. The results show that the transitions between the zones are no forbidden zones and that the average value of the probability is practically equal for the transitions within one zone and for the transitions from one zone into another, although the probability of a transition from the state with a wave vector k into a state k' is in a complicated way dependent on the angle between k and k'. Theory and experiment show that the interzone transitions play the same essential part in dispersions as the transitions within the zone. Therefore holes go over from a light into a heavy state and inversely on a distance of some free lengths of path. This explains the failure of the tests separately to determine the drift of the light

Card 1/2

Hole Dispersion in Germanium and Silicon 57-27-7-32/40

and the heavy holes. It is not at all possible separately to write down diffusion equations for the two types of holes as it was done by E. Ritter, Phys. Rev. 101, 1291, 1956. Both types of holes diffuse jointly with an average mobility and their concentration ratio is equal in all points. This paper was read on October 9-13, 1956 in Kiev on the meeting dealing with the theory of semiconductors. There are 1 table and 9 references, 3 of which are Slavic.

ASSOCIATION: Institute for Semiconductors AS USSR, Leningrad (Institut poluprovodnikov AN SSSR, Leningrad).

SUBMITTED: December 30, 1956

AVAILABLE: Library of Congress

1. Electrons-Diffusion 2. Germanium-Hole diffusion-Theory 3. Silicon-Hole diffusion-Theory 4. Semiconductors-Theory

Card 2/2

Pikus, G. Ye

AUTHORS: Pikus, G. Ye., Sorokin, O.V. 57-11-27/35

TITLE: A New Method of Measurement of Magnetic Field Intensity (Novyy metod izmereniya napryazhennosti magnitnogo polya)

PERIODICAL: Zhurnal Tekhn. Fiz., 1957, Vol. 27, Nr 11, pp 2647-2651, (USSR)

ABSTRACT: It is referred to earlier papers of the author in Zhurnal Tekhn. Fiz., 1956, Vol. 26,22 and Zhurnal Tekhn Fiz., 1957, Vol. 27, 1167 and here a new method for measuring magnetic fields is suggested which is based on the effect of a concentration modifiction of the current carriers in a semiconductor-pattern being situated in a weak magnetic field on the occasion of transmitting electric current through the pattern. The computations carried out give evidence of the possibility to measure magnetic fields of a voltage of $5.10^{3}$ up to $10^{-5}$ Oersted with a linear dependence of the measured electric voltage on the voltage of the magnetic field by means of this method. There are 3 figures and 5 Slavic references.

ASSOCIATION: Institute for Semi-Conductors AN USSR, Leningrad (Institut poluprovodnikov AN SSSR, Leningrad)

SUBMITTED: April 3, 1957

AVAILABLE: Library of Congress

Card 1/1

PIKUS, G.Ya. [Pikus, H.IA.]

Effect of electron bombardment of oxide cathodes on gas generation and thermionic emission [with summary in English]. Ukr. fiz. zhur. 3 no.3:329-342 My-Je '58. (MIRA 11:10)

1. Kiyevskiy gosudarstvennyy universitet im. T.G.Shevchenko.
(Cathodes) (Thermonic emission) (Gases)

Pikus, G. Ye.

1 3-2-2, 9

AUTHORS: Pikus, G. Ye., Sorokin, O. V. (Leningrad)

TITLE: A Non-Linear Semi-Conductor Resistance Sensitive to Magnetic Fields (Nelineynoye poluprovodnikovoye soprotivleniye, chuvstvitel'noye k magnitnomu polyu)

PERIODICAL: Avtomatika i Telemekhanika, 1958, Vol. 1?, Nr ., pp. ? ?-? (USSR)

ABSTRACT: This is a letter to the editor. With reference to References 1 - 6 the formula (1) is put down and the characteristics of a linear germanium resistance with electron-hole ... tion ... investigated. At room temperature the equation (2) is then ... tained ... $\Delta r = 0,093 \times 10^{-3} r_0 UH$, where $\Delta r$ denotes the complete variation of the electric resistance with ... under different conditions (according to References 1 - ...). $r_0$ denotes the resistance of the sample when there is no electric field present. Both are expressed in Ohms. U denotes the electric voltage at the sample in Volts. H denotes the strength of the magnetic field in Oersted. When the sample

Card 1/2

103-2-7/9

A Non-Linear Semi-Conductor Resistance Sensitive to Magnetic Fields

is located within the field of a constant magnet with H =1 the total resistance $r = r_o(1 + 0,1 U)$. An useful property of these non-linear resistances is the fact that the sign of the change of resistance, as it is to be seen from the formulae, depends on the direction of the electric- as well as of the magnetic field. The degree of non-linearity of the resistance can be increased if in place of a constant magnet an electromagnet is used which is fed from the same source from which the resistances themselves are fed. In this case also the dependence of r on H is made use of. The magnetic field strength is changed and thus the magnitude of the change of resistance can be independently influenced. There are 7 references, 6 of which are Slavic.

SUBMITTED: May 14, 1957

AVAILABLE: Library of Congress

1. Electrons-Conduction-Mathematical analysis

Card 2/2

SOV/57-28-10-29/40

AUTHORS: Bresler, S.Ye., Pikus, G.Ye.

TITLE: On the Theory of the Separation of Isotopes and of Alloy Components by Current Passage Through the Liquid Metal (K teorii razdeleniya izotopov i komponent splavov pri propuskanii toka cherez zhidkiy metall)

PERIODICAL: Zhurnal tekhnicheskoy fiziki, Vol 28, Nr 10, pp 2282-2288 (USSR)

ABSTRACT: In a previous paper (Ref 1) the authors developed a phenomenological theory of isotope separation by current passage through the liquid metal. It was assumed in this instance that the difference in the mobility of the ions is the cause for the ion separation. It was shown that the process of separation can be specified by a non-linear differential equation (1). The mechanism advanced in reference 1 is, however, not the only one that is possible (Refs 3 - 6), the interaction of the ions with the electrons not being taken into account in refernece 1. This is a more detailed study of the different separation mechanisms. It is shown that equation (1) gives a correct description of the separation process also under various other possible assumptions. The constant $\gamma$ contained in the equation is invested with different physical meanings according to the mechanism adopted:

Card 1/2

On the Theory of the Separation of Isotopes and of Alloy Components by Current Passage Through the Liquid Metal

SOV/57-28-10-29/40

$\gamma = Z\frac{\Delta \mu}{\mu}$, where $\Delta\mu = \mu_1 - \mu_2$ denotes the difference between the ion mobilities. There are 2 figures and 10 references, 3 of which are Soviet.

SUBMITTED: March 12, 1958

Card 2/2

PIKUS, G.Ye.

Relationship between different theories of the carrier scattering in semiconductors. Zhur. tekh. fiz. 28 no.11:2390-2401 N '58. (MIRA 12:1)

(Semiconductors)

PIKUS, G.Ye., red.; GESSEN, L.V., red.; ARTEMOVA, Ye., tekhn.red.

[Semiconductor surface physics; collection of articles] Fizika poverkhnosti poluprovodnikov; sbornik statei. Moskva, Izd-vo inostr.lit-ry, 1959. 423 p. (MIRA 13:5)
(Semiconductors)

PIKUS, G.Ye.; BIR, G.L.

Effect of deformation on the energy spectrum and electric properties of germanium and silicon with holes. Fiz.tver.tela 1 no.1: 154-156 Ja '59. (MIRA 12:4)
(Germanium--Electric properties)
(Silicon--Electric properties)
(Deformations (Mechanics)

~~24(6)~~ 24.7700

66252

SOV/181-1-7-8/21

AUTHORS: Pikus, G. Ye, Fiks, V. B.

TITLE: Electrokinetic Effects in Liquid Metals. I

PERIODICAL: Fizika tverdogo tela, 1959, Vol 1, Nr 7, pp 1062-1071 (USSR)

ABSTRACT: Liquid metal is assumed to be contained in a thin capillary tube. On the passage of current the wall or an immobile boundary layer receive a pulse in the direction of the electron current as a result of nonelastic electron scattering at the boundary. The inert mass of the liquid is given the same pulse in the opposite direction. In an open capillary tube this effect causes the liquid to flow, whereas an electroosmotic pressure, P, is produced in a closed tube. This results in the generation of convection currents - in the current direction on the walls, in the opposite direction in the center of the capillary tube - which causes the liquid particles to mix. The process is defined by substituting the so-called coefficient of convection diffusion, $D_k$. On the basis of the active forces, the equation for the steady flow of a viscous liquid, and the current distribution j(z) over the capillary tube cross section, Q is obtained as "transport current", that is the quantity of liquid passing through the capillary tube cross section

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Electrokinetic Effects in Liquid Metals. I SOV/181-1-7-8/21

per unit of time and length, for the open, round capillary tube:

$Q\big|_{\Delta P=0} = 0.1s(1-\varepsilon)\frac{en\,E\,\ell^2}{\eta}$. $\eta$ denotes viscosity, $\ell$ free path of the electron on the Fermi surface, $\varepsilon$ the reflection coefficient, and n the electron density. The electroosmotic pressure is obtained from $\nabla P = 0.8(1-\varepsilon)\ en\,E\,(\frac{\ell}{a})^2$, where a is the radius of the capillary tube.

$D_k = \frac{10^{-4}}{5.124\,D}\left(\frac{\nabla P\, d^3}{\eta}\right)^2$ results as diffusion coefficient for a plane capillary tube, $\frac{10^{-4}}{0.3072\,D}\left(\frac{\nabla P\, a^3}{\eta}\right)^2$ for a cylindrical capillary tube, where D denotes the ordinary diffusion coefficient. The phenomenon plays an important part in the separation of alloy components or isotopes. The above formulas hold for free electrons.

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Electrokinetic Effects in Liquid Metals. I SOV/181-1-7-8/21

If they ought to hold for bound electrons,

$$N_{eff} = -\frac{m}{4\pi^3 \hbar^2} \int \left(\frac{\partial \mathcal{E}}{\partial k_x}\right)^2 \frac{\partial f_o}{\partial \mathcal{E}} d\tau_k$$ is to be substituted for n.

$f_o$ denotes the Fermi function, $\mathcal{E}$ the electron energy. The following relations result for the "transport flow and potential" when using the principle of symmetry of Onsager's kinetic coefficients:

$$\bar{j}\Big|_{\nabla V=0} = -0.1(1-\varepsilon)\frac{e\ell^2 N_{eff}}{\eta}\nabla P \quad , \quad \Delta V\Big|_{j=0} = -0.1(1-\varepsilon)\frac{eN_{eff}\ell^2}{\sigma\eta}\Delta P .$$

A table shows the ratio of the electroosmotic pressure $\Delta P$ to $(1-\varepsilon)\,\Delta V$, of $\Delta V$ to $(1-\varepsilon)\,\Delta P$, and the ratio of the convection diffusion coefficient $D_k$ to $(1-\varepsilon)^2 E^2$ for sodium, potassium, lithium, and mercury. $\Delta V$ denotes the potential difference at the

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ends of the capillary tube, $\Delta P$ the pressure difference, E the field strength in the liquid. These values hold only for laminar flows. Theory and the values hold only if $\ell$ greatly exceeds the interatomic distance. All these data are also applicable to semiconductors. An exact solution for a cylindrical capillary tube is given in an appendix. There are 1 table and 10 references, 4 of which are Soviet.

ASSOCIATION: Institut poluprovodnikov AN SSSR, Leningrad (Institute of Semiconductors, AS USSR, Leningrad)

4

SUBMITTED: May 5, 1958

~~24 (6)~~ 24,2110

66264

AUTHORS: Fiks, V. B., Pikus, G. Ye

SOV/181-1-7-20/21

TITLE: Electrokinetic Effects and Electronic Viscosity in Liquid Metals.II

PERIODICAL: Fizika tverdogo tela, 1959, Vol 1, Nr 7, pp 1147 - 1158 (USSR)

ABSTRACT: When liquid metal contained in a thin capillary tube is caused to flow through it, "transport current" is produced on the wall as a result of nonelastic electron scattering. It is shown here that the "transport current", which is produced in the volume by nonuniform velocity distribution over the capillary tube cross section, leads to what is called electronic viscosity of the liquid metal. An additional expression for the "transport current" density is obtained by solving the kinetic equation. "Transport current I" itself is then defined by the relation $I \simeq -0.1(1-\varepsilon)enl^2d\frac{\nabla P}{\eta}$. When the "transport current" is assumed to consist of two parts, i.e. the current in the volume and the surface current, it holds: $I = -0.1s(1-\varepsilon)enl^2d\frac{\nabla P}{\eta}$. The "transport potential" at the ends of the open conductor is given by

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Electrokinetic Effects and Electronic Viscosity in Liquid Metals.II SOV/181-1-7-20/21

the relation $\Delta V|_{I=0} = -0.1(1-\varepsilon)\frac{enl^2}{\sigma\eta}\Delta P$ (for denotation see Paper 1). These formulas apply to free electrons. For bound electrons, n is to be transformed into $N_{eff} = -\frac{m}{4\pi\hbar^2}\int\left(\frac{\partial\varepsilon}{\partial k_x}\right)^2\frac{\partial f_0}{\partial\varepsilon}d\vec{\tau}_k$, where $\varepsilon$ denotes the electron energy, $\vec{k}$ its quasi-momentum. By transforming wave vector $\vec{k}$ in the transition from the moving to the immobile coordinate system it is shown that the transformation of n into $N_{eff}$ is correct. The "transport current" influences the flow of the liquid, which is termed secondary electrokinetic effect. The velocity distribution along the cross section does not change, while the viscosity of the liquid changes. $\eta_e = \frac{1}{5}\frac{enl^2}{\mu}$ is the contribution made by electrons to the viscosity. This is called electronic viscosity. It is shown by R. Cambers' method that the formula set up for the volume current holds also for the general case and, accordingly, also the expression for electronic viscosity. Its special measurement is difficult; according to the table,

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67395
SOV/181-1-9-17/31

24.7700
~~24(3), 24(6)~~

AUTHORS: Zhuze, V. P., Pikus, G. Ye., Sorokin, O. V.

TITLE: Application of the Magnetostriction Effect to the Investigation of the Surface of Semiconductors

PERIODICAL: Fizika tverdogo tela, 1959, Vol 1, Nr 9, pp 1420 - 1430 (USSR)

ABSTRACT: The authors used the method of surface recombination rate measurement by means of the resistance change of a semiconductor in the magnetic field to investigate the energy surface structure of germanium. This investigation is reported here in all details. The method applied to measure the surface recombination rate is new and was introduced by the authors themselves. A description thereof is given in references 4 and 5. The aim of the investigation under review was that of demonstrating the application of this method, with two samples of n- and p-germanium being used for the purpose. Figure 1 shows the block diagram of the used setup. The method is based on the application of a formula describing the relation between the resistance change $\Delta \varrho_H$ of a thin plane sample in the magnetic field H and the recombination rates $s_1$

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Application of the Magnetostriction Effect to the Investigation of the Surface of Semiconductors SOV/181-1-9-17/31

and $s_2$ on their opposite faces: $\Delta \varrho_H/\varrho_o = 2A\mathcal{E}_\nu H \frac{s_1-s_2}{s_1+s_2+\alpha/\tau}$, where d is the sample thickness, $\mathcal{E}_\nu$ the voltage of the main frequency $\nu$, which is incident upon the investigated part of the sample, $\varrho_o$ is the resistivity without magnetic field. A is given by $A = \frac{a_n}{4}\frac{e\mu_n}{ckT}\frac{(1+b)(1+\gamma b)pn}{(n+p)(n+pb)}\frac{d}{l}$, where n and p denote the equilibrium concentrations of electrons and holes, $\mu_n$ and $\mu_p$ their drift mobility, $a_n\mu_n$ and $a_p\mu_p$ their Hall mobility, and l the length of the investigated part of the sample. It is now described how it is possible, by means of the instrument, to obtain direct oscillograms reproducing the dependence of the quantity $\frac{s_1-s_2}{s_1+s_2+\alpha/\tau}$ on the applied field. Figures 2-5 show such oscillograms for the two samples investigated, whose characteristics are given. The next section discusses the 4

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Application of the Magnetostriction Effect to the Investigation of the Surface of Semiconductors SOV/181-1-9-17/31

interpretation of measuring results in detail; the results are given in the form of diagrams, and the numerical values are given in two tables. The method described is very expedient for a quick and fairly accurate determination of the field-bound change of s. A. V. Rzhanov, I. A. Arkhipova, and V. N. Bidulya (Ref 12) applied this method to investigate the modulation of s through an outer electric field. Their results, however, did not fit those by the authors in two points. This is discussed in the final part of the paper. There are 10 figures, 2 tables, and 15 references, 8 of which are Soviet.

ASSOCIATION: Institut poluprovodnikov AN SSSR Leningrad (Institute of Semiconductors of the AS USSR, Leningrad)

SUBMITTED: February 16, 1959

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66267

SOV/181-1-11-2/27

~~24(3)~~ 24.7700

AUTHORS: Pikus, G. Ye., Bir, G. L.

TITLE: The Influence of a Deformation on the Energy Spectrum of the Holes in Germanium and Silicon

PERIODICAL: Fizika tverdogo tela, 1959, Vol 1, Nr 11, pp 1642-1658 (USSR)

ABSTRACT: One of the possibilities of investigating the zone structure of semiconductors is the investigation of the electric properties of deformed semiconductors. First, the authors give an introductory discussion of some of the papers already published on this subject, especially those by Smith (Ref 1) and Adams (Ref 5) concerning the piezoelectric resistance in n- and p-type germanium and silicon. The theory of these effects has been worked out in detail for n-germanium, while the effects of deformation on the electric properties of p-germanium have not been investigated in detail theoretically - apart from a short communication by Adams concerning the changes in the hole spectrum of a deformed crystal, which are also described briefly. In the present paper the authors carry out a more detailed theoretical investigation of the effect deformations have on the various electric properties of semiconductors with the aim of obtaining more detailed knowledge of the zone struc-

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SOV/181-1-11-2/27

The Influence of a Deformation on the Energy Spectrum of the Holes in Germanium and Silicon

ture and -parameter and the mechanism of carrier scattering. An expression is derived for the hole spectrum in deformed germanium and silicon. The energy limits are calculated from the general formula. One of these limits, valid at a sufficiently great distance from the boundary of the zone, agrees with the expression obtained by Adams apart from a numerical factor in one of the terms. It follows from the formulas derived that while the effect of the piezoelectric resistance is comparatively small and proportional to the deformation at high temperatures, the deformed crystals exhibit a marked anisotropy of their electric properties at sufficiently low temperatures. In general, the degree of anisotropy depends not on the degree of deformation, but only on its direction. At the beginning of the paper, which is divided into three parts, a mathematical analysis is given of the valence zone in a deformed lattice. An expression is derived for the energy of the holes at the space point k $E(\vec{k},\varepsilon)$. Then, the special cases of low and high temperatures are investigated, and the formulas obtained are evaluated numerically (Table 2). The course of the functions E(k) for

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unilateral deformation and shearing deformation is illustrated in the figures 1 and 2. In an appendix, the authors calculate $E(\varepsilon, \vec{k})$ with exact allowance for spin-orbit interaction. The authors thank A. I. Ansel'm for reading of proof and for valuable remarks. There are 2 figures, 2 tables, and 14 references, 2 of which are Soviet.

ASSOCIATION: Institut poluprovodnikov AN SSSR Leningrad (Institute for Semiconductors AS USSR, Leningrad)

SUBMITTED: December 2, 1958

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PIKUS, G. Ye.; BIR, G.L.

Effect of deformation on the electrical properties of p-type germanium and silicon. Fiz.tver.tela 1 no.12:1828-1840 D '59. (MIRA 13:5)

1. Institut poluprovodnikov AN SSSR, Leningrad.
(Germanium--Electric properties)
(Silicon--Electric properties)

S/181/60/002/01/15/035
B008/B011

24.2110

AUTHORS: Fiks, V. B., Pikus, G. Ye.

TITLE: Electrokinetic Effects in Liquid Semiconductors

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 1, pp. 65 - 66

TEXT: The authors investigated the phenomena brought about by the formation of a volume charge layer on the semiconductor surface. They resemble the electrokinetic phenomena to be seen in electrolytes and can be determined in a similar manner. Since, however, the conductivity of a semiconductor is considerably lower, appreciably stronger fields can be generated therein, and the phenomena themselves can be stronger as compared with metals. The measurement of electrokinetic phenomena allows a direct determination of the potential difference $\varphi_0$ between the surface of the semiconductor and the volume. If the capillary walls are metalized from within, and there are no additional charges on the semiconductor surface, $\varphi_0$ then equates the potential difference of the contact between metal and semiconductor. If the capillary walls are dielectric, $\varphi_0$ is only determined by the charge on the surface levels.

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Electrokinetic Effects in Liquid Semiconductors S/181/60/002/01/15/035
B008/B011

If the capillary is metalized from outside, the charge can be changed in the layer near the interface by the generation of a transverse electric field between metal and semiconductor. Much like in experiments with the field effect (Ref. 2), the charge on the surface traps and the volume charge produced by the carriers can be determined by measuring the dependence of $\varphi_0$ on the induced charge. There are 2 Soviet references.

ASSOCIATION: Institut poluprovodnikov AN SSSR, Leningrad (Institute of Semiconductors, AS USSR, Leningrad)

SUBMITTED: May 14, 1959

Card 2/2

81967

S/181/60/002/04/29/034
B002/B063

5.5800

AUTHORS: Fiks, V. B., Pikus, G. Ye.

TITLE: Analysis of Microimpurities by Means of a Magnetic Resonance Mass Spectrometer

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 4, pp. 716-727

TEXT: When high-purity materials are subjected to a mass-spectrometric analysis, their sensitivity is considerably reduced by the background formed by molecules and atoms of the residual gas. This drawback could be largely avoided by two or three spectrometers connected in series. However, such a setup is very complicated. In the paper under review, the authors suggest a so-called resonance mass spectrometer which is based on the principle of a synchrocyclotron. The particles are electrically accelerated and then forced to enter almost circular paths by means of a magnetic field. With the aid of electric pulses, the particles are accelerated in packets. The rest comes out of phase (Figs. 1 and 2). The authors calculated the resolution of the instrument and the sensitivity in the analysis of microimpurities. The measurable minimum concentration is, theoretically, about

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81967

Analysis of Microimpurities by Means of a Magnetic Resonance Mass Spectrometer

S/181/60/002/04/29/034
B002/B063

$10^{-9}$. This requires the highest number of pulses possible, i.e., the highest number of ion packets possible per unit of time; a low resolution; and a small number of revolutions in the magnetic field. There are 3 figures and 10 references: 6 Soviet and 4 British.

ASSOCIATION: Institut poluprovodnikov AN SSSR, Leningrad (Institute of Semiconductors of the AS USSR, Leningrad)

SUBMITTED: July 22, 1959

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Pikus G.Ye

81968
S/181/60/002/04/33/034
B002/B063

24.2120

AUTHORS: Moyzhes, B. Ya., Pikus, G. Ye.

TITLE: The Theory of a Plasma Thermocouple

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 4, pp. 756-774

TEXT: Following a suggestion of Academician A. F. Ioffe the authors of the present paper carried out a theoretical investigation of the physical phenomena observed in plasma thermocouples. Plasma thermocouples convert electric energy into thermal energy in a cesium gas in which the mean free path of the electrons and ions is considerably shorter than the spacing of the cathode and the anode. The current-voltage characteristic and the efficiency for boundary conditions were calculated: 1) Isothermal plasma; 2) no energy exchange between electrons and atoms. An example with the following initial data was calculated: temperature of the cathode: 2,300°K; temperature of the anode: 690°K; spacing: 2mm; cesium pressure: 1 torr; anodic work function: 1.2 ev (Figs. 3 and 4). Hence, the efficiency amounted to 27 per cent. Mention is made of A. I. Ansel'm. There are 6 figures and 19 references: 4 Soviet, 10 American, 4 British, and 1 German.

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81968
S/181/60/002/04/33/034
B002/B063

The Theory of a Plasma Thermocouple

ASSOCIATION: Institut poluprovodnikov AN SSSR, Leningrad (Institute of Semiconductors of the AS USSR, Leningrad)

SUBMITTED: December 9, 1959

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9,4300 (1035, 1138, 1143)

84090
S/181/60/002/009/033/036
B004/B056

AUTHORS: Bir, G. L., Pikus, G. Ye.

TITLE: The Theory of the Deformation Potential for Semiconductors With Complex Band Structure 21

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 9, pp. 2287-2300

TEXT: In the introduction, the authors discuss the advantages of the deformation potential method suggested in 1950 by J. Bardeen and W. Shockle (Ref. 1), as well as by S. I. Pekar and M. F. Deyger (Ref. 2). In the present paper, they derive the operator for the interaction of the electron with long-wave phonons for the case of an arbitrary degeneracy of the bands, employing the method developed by I. M. Luttinger and W. Kohn (Ref. 4). Here, the matrix expressing the interaction between the electron and acoustic oscillations is identical with the matrix determining the change in the energy of the carriers in uniform deformation and which had been derived by the authors in Ref. 5. Furthermore, the method of deformation potentials is used for describing the interaction between electron and long-wave optical oscillations. In this case, the constants

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The Theory of the Deformation Potential for Semiconductors With Complex Band Structure

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S/181/60/002/009/033/036
B004/B056

of the theory cannot be determined immediately from the data of the piezoelectric resistance. The influence of spin-orbit interaction is discussed. The results obtained are used for calculating the transition probabilities for holes in germanium and silicon. Precise expressions for the transition probability in scattering on lattice vibrations are obtained. These results are intended to be used for developing a theory of galvanomagnetic effects in p-type germanium. The authors thank A. I. Ansel'm and S. I. Pekar for perusing the manuscript and for discussions. There are 8 references: 4 Soviet and 4 US.

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ASSOCIATION: Institut poluprovodnikov AN SSSR, Leningrad (Institute of Semiconductors of the AS USSR, Leningrad)

SUBMITTED: February 23, 1960

Card 2/2

9.4300 (1143, 1155)

S/181/60/002/012/016/018
B006/B063

AUTHORS: Pikus, G. Ye. and Fiks, V. B.

TITLE: Microimpurity Analysis by Means of a Magnetic Resonance Mass Spectrometer. II. Calculation of the Background Current

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 12, pp. 3110-3128

TEXT: The accuracy of mass-spectrometric microimpurity analysis is limited chiefly by the background current which is due to ions of the main beam components inciding upon the receiver after scattering in the residual gas. The most effective method of eliminating the scattered-ion background is to use several spectrometers in stage operation. Part I of the present paper has shown that a magnetic resonance mass spectrometer can be used as a multistage separator, in which each revolution of the ions constitutes a stage of the separating cascade. The present paper presents a calculation of the background current in such a device which is schematically represented in Fig. 1; q is the source of the ion beam which is bent in the magnetic field and hits a three-grid modulator m. A positive retarding voltage $V_3$, which is higher than the accelerating

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Microimpurity Analysis by Means of a Magnetic Resonance Mass Spectrometer. II. Calculation of the Background Current

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B006/B063

voltage ($V_q$) in the source, is applied to the central grid of the m[illegible]. Accelerating pulses (amplitude: $V_m$; interval: $T_m$; duration: τ) reach grid C of the modulator. As $V_m > (V_3 - V_q)$, an accelerating field is produced in the modulator after some time, in which the energy of the penetrating ions is increased by $\Delta E_i$. The period of revolution $T_i$ is given as $T_i = kT_m$, k=1,2,... Denoting the ion mass by $M_i$ gives $T_i = 652\cdot10^{-6}(M_i/H)$ sec. The total current hitting the collector is proportional to k. A retarding field reflecting the scattered ions is produced in front of the collector. The two accelerating fields (in the modulator and in front of the collector) eliminate those components of the background current which are due to scattering of non-resonance ions by the collector and to multiple revolution of non-resonance ions. The authors have studied that background current which is due to ion-beam shuttering. This effect cannot be eliminated by retarding fields. The portion of ions scattered by the residual gas is called the shuttering coefficient w; the background current is given by [illegible]

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Microimpurity Analysis by Means of a Magnetic Resonance Mass Spectrometer. II. Calculation of the Background Current

S/181/60/002/012/018/018
B006/B063

$I_0$ is the current of the main component. The authors consider only the case where beams of ions of similar masses overlap, since ions with largely differing masses usually do not reach the slit of the modulator. For ions reaching the slit of width L, the conditions $\Delta M/M \leq L/R$ must be satisfied, where $\Delta M$ is the difference in mass of resonance and scattered ions. For this case, the authors investigate the effect of operation parameters and derive explicit formulas for w. These expressions are then applied to some special cases: 1) scattering by induced dipoles; 2) scattering by molecules with rigid dipoles. In the first case one obtains $w \approx 4.10^{-6}$ for ions with $\Delta M/M \simeq 10^{-2}$ and $w \approx 3.10^{-4}$ for ions with $\Delta M/M \simeq 10^{-3}$. In the second case one finds $w = 1.4 \cdot 10^{-6}$ $(\Delta M/M = 10^{-2})$ and $w = 5.10^{-4}$ $(\Delta M/M = 2.10^{-3})$. Since the total shuttering coefficient in a resonance mass spectrometer after N revolutions equals $w^N$, it is sufficient to choose $N = 3 - 4$ for eliminating the background due to scattering. There are 4 figures and 4 references: 3 Soviet and 1 US.

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Microimpurity Analysis by Means of a Magnetic Resonance Mass Spectrometer. II. Calculation of the Background Current

S/181/60/002/012/018/018
B006/B063

ASSOCIATION: Institut poluprovodnikov AN SSSR Leningrad (Institute of Semiconductors AS USSR, Leningrad)

SUBMITTED: May 16, 1960

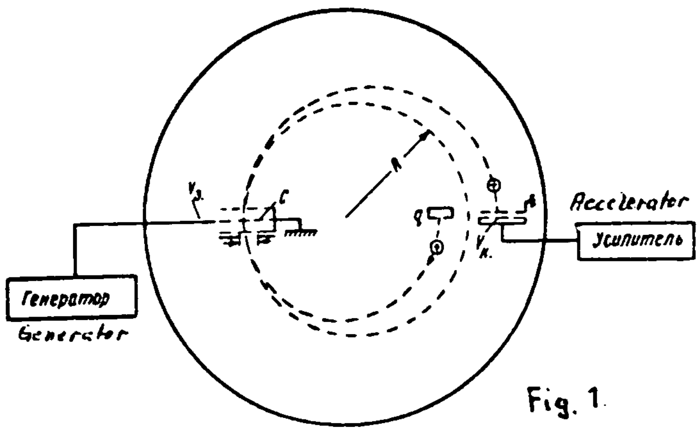


Fig. 1

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PIKUS, G.Ye.

Effect of a magnetic field on the operation of a plasma thermoelement. Zhur.tekh.fiz. 31 no.8:1013-1016 Ag '61.
(MIRA 14:8)

1. Institut poluprovodnikov AN SSSR, Leningrad.
(Thermoelectric apparatus and appliances)
(Plasma (Ionized gases) (Magnetic fields)

PIKUS, G.Ye.

New method for calculating the energy spectrum of current carriers in semiconductors. Part 1. Case when spin-orbit interaction is not taken into account. Zhur.eksp.i teor.fiz. 41 no.4:1258-1273 O '61. (MIRA 14:10)

1. Institut poluprovodnikov AN SSSR.
(Semiconductors--Electric properties) (Quantum theory)

BIR, G.L.; PIKUS, G.Ye.

Effect of deformations on the energy spectrum and electric properties of semiconductors of the InSb type. Fiz.tver.tela 3 no.10:3050-3069 O '61. (MIRA 14:10)

1. Institut poluprovodnikov AN SSSR, Leningrad.
(Deformations (Mechanics)) (Semiconductors--Electric properties)
(Crystal lattices)

PIKUS, G.Ye.

New method for calculating the energy spectrum of current carriers in semiconductors. Part 2. Spin-orbital interaction taken into account. Zhur. eksp i teor. fiz. 41 no.5:1507-1521 N '61. (MIRA 14:12)

1. Institut poluprovodnikov AN SSSR.
(Quantum theory) (Semiconductors)

20803

S/181/61/003/003/030/030
B102/B205

9,4300 (1055, 1143, 1137)

AUTHORS: Pikus, G. Ye. and Bir, G. L.

TITLE: Cyclotron and paramagnetic resonance in deformed crystals

PERIODICAL: Fizika tverdogo tela, v. 3, no. 3, 1961, 1001-1004

TEXT: This is the continuation of two earlier papers, in which the authors described the effect of deformation on the energy spectrum of holes in germanium-type lattices. It was shown that the isoenergetic surfaces near the extremum in the deformed crystals are ellipsoids, and that the effective masses depend largely on the direction of deformation and determine three constants (A, B, D), such as the spectrum in an undeformed crystal. These constants were determined in Ref. 3 with high accuracy. From Refs 3-5 (see below) it may be seen that significant data on band structure and impurity centers can be obtained by a study of resonance effects on deformed crystals. In this connection, a theoretical study has been made of some new possibilities of determining the cyclotron and paramagnetic resonance of deformed crystals. Measurement of the cyclotron resonance of deformed p-type Ge or Si permits the determination of A, B, and D, as well as of

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S/181/61/003/007/010/030
B102/B205



the ratio b/a of the constants of the deformation potential. On elongation ($\varepsilon$) in the [110] direction, the reciprocal effective masses $\hbar^2/2m_i^*$ in the directions [110], [$\bar{1}$10], and [001] are given by (1), where the upper sign corresponds to the case of $d\varepsilon < 0$, and the lower sign to $d\varepsilon > 0$. The resonance effects of InSb-type deformed crystals are of special interest. Because of the absence of an inversion center in these crystals, the inclination at $\vec{k} = 0$ does not vanish. The terms linear in $\vec{k}$, which appear when the spin-orbit interaction is taken into account, are small. Taking these terms into account, the spectrum for deformed p-type InSb crystals is now calculated for both small and great $\vec{k}$. In the case of small $\vec{k}$, the following relation holds for the lowest band (minimum hole energy):

$E(\vec{k}) = E^{o}(\vec{k}) \pm \frac{\mathcal{K}}{\sqrt{\mathcal{E}_\varepsilon}} \left(\sum_{i,j} \alpha_{ij}k_ik_j\right)^{1/2}$, where $E^{o}(\vec{k})$ is a solution taken from Ref. 2 (FTT I, 1642, 1959). $\alpha_{xx} = 3b^2(\varepsilon_{yy} - \varepsilon_{zz})^2 + 4d^2(\varepsilon_{xy}^2 + \varepsilon_{xz}^2)$ and $\alpha_{xy} = -2\sqrt{3}\mathcal{E}_\varepsilon d\varepsilon_{xy} + 2d^2\varepsilon_{xz}\varepsilon_{yz}$; $\mathcal{E}_\varepsilon$ is also taken from Ref. 2. This formula

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B102/B205

Cyclotron and ...

holds for such deformations in which the band splitting equal to $2|\mathcal{E}_1|$ exceeds both kT and $E(0) - E(\vec{k})_{min}$. For deformations in the directions [001] and [111] one obtains

$$b\varepsilon_{zz} > 0 \quad E_{1,2}(\mathbf{k}) = \left(A + \frac{B}{2}\right)(k_\perp \pm k_{\perp 0})^2 + (A - B)\,k_z^2, \tag{3}$$

$$b\varepsilon_{zz} < 0 \quad E_{1,2}(\mathbf{k}) = \left(A - \frac{B}{2}\right)(k_\perp \pm k_{\perp 0})^2 + (A + B)\,k_z^2, \tag{4}$$

где $k_\perp^2 = k_x^2 + k_y^2$, а $k_{\perp 0} = \frac{\sqrt{3}}{2}\frac{|\mathcal{K}|}{A \pm \frac{B}{2}}$, соответственно.

$$d\varepsilon_{xy} > 0 \quad E_{1,2}(\mathbf{k}) = \left(A + \frac{D}{2\sqrt{3}}\right)(k_\perp \pm k_{\perp 0})^2 + \left(A - \frac{D}{\sqrt{3}}\right)k_z^2, \tag{5}$$

$$k_{\perp 0} = \frac{|\mathcal{K}|}{A + \frac{D}{2\sqrt{3}}}.$$

$$d\varepsilon_{xy} < 0 \quad E_{1,2}(\mathbf{k}) = \left(A - \frac{D}{2\sqrt{3}}\right)k_\perp^2 + \left(A + \frac{D}{\sqrt{3}}\right)(k_z \pm k_{z0})^2. \tag{6}$$

$$k_{z0} = \sqrt{2}\,\frac{|\mathcal{K}|}{\left(A + \frac{D}{\sqrt{3}}\right)}.$$

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20803
S/181/61/003/003/030/030
B102/B205



The isoenergetic surfaces in InSb on deformation along [100] and [111] are toroidal for $d\varepsilon > 0$; the extremum lies on a ring with $k_{\perp} = k_{\perp 0}$. Semiconductors of this type have not yet been discovered. E. I. Rashba (FTT, 2, 162, 1959) has made an exact theoretical study of semiconductors with such a spectrum and predicted combined resonance for them. Using formulas from Ref. 2, a study of the spin resonance on p-type Ge and Si leads to

$$(\hbar\omega_{s})^{2}=\frac{\mu_{0}^{2}k^{2}}{\mathcal{E}_{1}}\langle \mathbf{H}, \mathbf{H}\rangle, \tag{7}$$

$$\langle \mathbf{A}, \mathbf{B}\rangle=\sum_{ij}\beta_{ij}A_{i}B_{j}. \tag{8}$$

$$\beta_{xx}=[\sqrt{\mathcal{E}_{1}}+b(\Delta-3\varepsilon_{xx})]^{2}+3d^{2}(\varepsilon_{xy}^{2}+\varepsilon_{xz}^{2}),$$

$$\beta_{xy}=\sqrt{3}d\,(\sqrt{3}d\varepsilon_{xz}\varepsilon_{yz}-\varepsilon_{xy}[2\sqrt{\mathcal{E}_{1}}-b(\Delta-3\varepsilon_{zz})])$$

$$\Delta=\varepsilon_{xx}+\varepsilon_{yy}+\varepsilon_{zz}.$$

20803
S/181/61/003/003/030/030
B102/B205

Cyclotron and ...

For deformations along [001] or [111] one obtains (9)

$$(\hbar\omega_n)^2 = \mu_0^2 k^2 (g_{\parallel}^2 H_z^2 + g_{\perp}^2 H_{\perp}^2),$$

$$g_{\parallel}^2 = (1 \mp 2)^2, \; g_{\perp}^2 = (1 \pm 1)^2, \; H_{\perp}^2 = H_x^2 + H_y^2. \qquad (9)$$

(upper sign: $b\varepsilon > 0$ or $d\varepsilon > 0$; lower sign: $b\varepsilon < 0$ or $d\varepsilon < 0$). Measurement of this resonance (resonance frequency $\omega_n$) makes it possible to determine b and d and, thus, B, and D. b/d can be determined from measurements of resonance in the case of other directions of deformation. These formulas are valid only, for such holes, for which $E(\vec{k}) \ll \Delta E = 2|\varepsilon_i|$. $\omega_n$ depends not only on b and d but also on the form of the wave function of the impurity center. For slight deformations, $\Delta\omega_n/\omega_n \simeq 2|\varepsilon_i|/E_i$, where $E_i$ is the activation energy of the impurity center. There are 14 references: 6 Soviet-bloc and 7 non-Soviet-bloc. The references to English-language publications read as

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20803
S/181/61/003/003/030/030
B102/B205

Cyclotron and ...

follows: Ref. 3: J. C. Hensel, G. Feher, Phys. Rev. Letters 5, 307, 1960; Ref. 4: Feher, Hensel, Gere, Phys. Rev. Letters 5, 309, 1960; Ref. 5: Dresselhaus, Kip, Kittel, Phys. Rev. 98, 368, 1955.

SUBMITTED: December 15, 1960

Card 6/6

PIKUS, G.Ye.

Energy spectrum in crystals with a tellurium lattice, taking spin-orbital interaction into account. Fiz. tver. tela 3 no. 9:2809-2812 S '61. (MIRA 14:9)

1. Institut poluprovodnikov AN SSSR, Leningrad.
(Crystal lattices)

29691
S/181/61/003/010/016/036
B111/B108

24.7700 (1164,1385,1559)

AUTHORS: Bir, G. L., and Pikus, G. Ye.

TITLE: Effect of deformation on the energy spectrum and electrical properties of InSb-type semiconductors

PERIODICAL: Fizika tverdogo tela, v. 3, no. 10, 1961, 3050-3069

TEXT: The authors studied the effect of deformation on the electrical properties, and particularly on the carrier energy spectra of p-type and n-type InSb and of n-type GaAs at low and high temperatures. The energy band degeneracy, which occurs in the k-space in crystals of high symmetry, is eliminated by deformation. Resistivity and other thermal and galvanomagnetic factors are greatly changed as a result. The InSb valency band has three-fold degeneracy at $\vec{k} = 0$. The conduction band at $\vec{k} = 0$ is only degenerate in respect of spin. Interaction between this s-band and the valency p-band is very considerable, due to the small width of the forbidden band. The study made for n- and p-type InSb only concerns effects arising at low temperatures. Instead of the X

Card 1/4

perturbation theory, a more general method developed by G. Ye. Pikus (Ref. 11: ZhETF, 41, no. 4(10), 1961; Ref. 12: ZhETF, 41, no. 5(11), 1961) was used for the calculation. Many formulas are taken from these two papers and also from Ref. 6 (G. Ye. Pikus, G. L. Bir. FTT, 1, 139, 1959; 1, 1642, 1959). (1) Valency band: The following holds for the Hamilton operator $\hat{\mathcal{L}}$:

$$\hat{\mathcal{D}} = B_1 k^2 + B_2 \sum_i J_i^2 k_i^2 + B_3 \sum_{i>j} [J_i J_j] k_i k_j + a_1 \sum_i k_i \hat{V}_i +$$
$$+ C_1 \varepsilon + C_2 \sum_i J_i^2 \varepsilon_{ii} + C_3 \sum_{i>j} [J_i J_j] \varepsilon_{ij} + C_4 \sum_i J_i k_i (\varepsilon_{i+1,i+1} - \varepsilon_{i+2,i+2}) +$$
$$+ C_5 \sum_i J_i (\varepsilon_{i,i+1} k_{i+1} - \varepsilon_{i,i+2} k_{i+2}), \tag{1}$$

where $2[J_i J_j] = J_i J_j + J_j J_i$, $2\{J_i J_j\} = J_i J_j - J_j J_i$, $V_x = J_x (J_y^2 - J_z^2)$, $\varepsilon = \mathrm{Sp}\,\varepsilon$.
where $i = x, y, z$; $i + 3 = i$. Only the first three terms were considered in case of p-type germanium. $B_i$, $C_i$ are of zeroth order in $\beta^2$ ($\beta = \bar{v}/c$); $a_1$, a very small quantity, is of first order in $\beta^2$. In general, only those terms are considered in $\mathcal{D}$ which are linear in $\vec{k}$ and

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29691 S/181/61/003/010/016/036
B111/B138

Effect of deformation on the ...

of zeroth order in ;². The authors restrict themselves to the case of not very large deformations for which: = o+ '. o is calculated by Eq. (13) from Ref. 6. The matrix is indicated for '. The eigenvalues of o have two-fold degeneracy. At low temperatures, deformation in the 100 and 111 directions is discussed in particular. Similar formulas are given for high temperatures. In deformation, the temperature dependence of resistivity of p-type InSb has the form a+ /T. This deviation from theory can be attributed to the presence of several scattering mechanisms; not so, however, the high value of a. The constants b and d taken over from Ref. 6 are estimated by using data from Ref. 4 (R. F. Potter, Phys. Rev., 108, 3, 652, 1957) and Ref. 5 (A. Tuzzolino, Phys. Rev., 109, 6, 1958). Characteristically, b is smaller than d by about one order of magnitude, and both constants are negative. (2) Conduction band: At low energies interaction between s- and valency p-band leads to a marked deviation from the dispersion law, causing the magnetic moment of electrons to be highly dependant on their energy. On deformation this interaction must cause a considerable change in effective mass and the deformation potential constants.

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29691
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B111/B138

Effect of deformation on the ...

$$\mathscr{D} = \Delta_1 A_0 + 2i\Delta_2 \sum_i \sigma_i \{A_{i+1} A_{i+2}\} + [B_1 - L' - M] A_0 k^2 + + (L' - M) \sum_i A_i k_i^2 + 2N \sum_{i>j} [A_i A_j] k_i k_j + B_2 \sum_i A_i' k_i + + B_3 \sum_i A_i k_{i+1} k_{i+2} + [C_1 - (l - m)] A_0 \varepsilon + m(1 - A_0)\varepsilon + + (l - m) \sum_i A_i \varepsilon_{ii} + 2n' \sum_{i>j} [A_i A_j] \varepsilon_{ij} + C_2 \sum_i A_i \varepsilon_{i+1,\, i+2}$$

where $2\{A_i A_j\} = A_i A_j - A_j A_i$ и $2[A_i A_j] = A_i A_j + A_j A_i$.

holds for . $2\Delta_2$ is the spin-orbital splitting, $E_g = \Delta_1 - \Delta_2$ is the distance of the s-band from the nearest valency p-band. The two limiting cases: $E_g \gg 2\Delta_2$ and $E_g \ll 2\Delta_2$, are examined. (a) Semiconductors with a narrow forbidden band: $E_g = 0.23$ ev, $2\Delta_2 = 0.9$ ev. The matrix for $\mathscr{D}$ is written explicitly, and the eigenvalues are calculated. It is found that both isotropic and anisotropic deformation cause a relatively large variation in the effective mass of n-type InSb. An interesting aspect is that the variation of effective mass by anisotropic deformation is

X

Card 4/6

26703
S [illegible]
B102/B108

24.7700 (1144, 1160)

AUTHOR: Pikus, G. Ye.

TITLE: A new method of calculating the energy spectrum of current carriers in semiconductors. II. Spin-orbit coupling is taken into account

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 41, [illegible]

TEXT: In a previous paper (Ref. 1: ZhETF, 41, 1258, 1961) the author developed a method to build up the Hamiltonian $\hat{\mathcal{H}}$ in effective-mass approximation. In the present paper this method is generalized in order to take account of the spin-orbit interaction. Denotations, definitions and basic formulas are taken from Ref. 1. Two different methods make it possible to introduce a term describing spin-orbit interaction into the Hamiltonian. The first one is based on the assumption that the interaction term is small and can be introduced into the Hamiltonian as a perturbation. The second method is based on the fact that $\hat{\mathcal{H}}_{s-o}$ is independent of $\mathcal{K}$ and is of the same symmetry as $\hat{\mathcal{H}}_0$ so that it can be introduced directly into $\hat{\mathcal{H}}_0$

Card 1/3

26703

S/... 
B10., B108

A new method of calculating...

(Ref. 1). A comparison of the results of both methods shows that for weak spin-orbit interaction they go over into each other. In the following the author considers two problems to which these methods can be applied. ... Effect of determination of the energy spectrum of Wurtzite type crystals. The problem was solved ... in Ref. ... without taking spin-orbit interaction into account. Here it is solved for the CdS spectrum in the ... band model with $\Lambda_S \lessgtr \Lambda_S$ and for the Thomas Hopfield model with $\Lambda_{S-} > \Delta_S$. ... is set up for the representation ... $\Lambda$ ... in the spin-orbital splitting. $\mathcal{D}$ is determined by the first method using the ... $\Gamma$ and $\Gamma$. $\mathcal{D}$ is determined by the first method ... investigated by E. I. Rashba (FTT ...) ... and ... Ref. ... No general expression ... derived. The two ... cases ... $\Delta \gg \Delta$ ... and $\Delta ... \gg \Lambda$ are considered. ... the spectrum ... using the first method. ... The change of the energy spectrum ... The spectrum ... investigated ... of the points with ... degenerate representation ... $\Gamma$ ... the center of the Brillouin ... point $\Lambda$ at its edge on the [...] axis. ...

Card .../...

26703
S/056/61/041/005/016/038
B102/B108

A new method of calculating...

advice. A. I. Ansel'm, E. I. Rashba and G. L. Bir for discussions, and V. I. Sheka for proof-reading. There are 1 figure, 7 tables, and 15 references: 9 Soviet and 6 non-Soviet. The four most recent references to English-language publications read as follows: J. L. Birman. Phys. Rev. 116, ..., ...; 114, 1490, 1959; D. J. Thomas, J. J. Hopfield. Phys. Rev. 119, ..., 1960; J. M. Luttinger. Phys. Rev. 102, 1030, 1956. C. Smith. Phys. Rev. 94 ...

ASSOCIATION: Institut poluprovodnikov Akademii nauk SSSR (Institute of Semiconductors of the Academy of Sciences USSR)

SUBMITTED: May ...

Card 3/3

BIR, G.L.; NORMANTAS, E.; PIKUS, G.Ye.

Galvanomagnetic effects in semiconductors with degenerated zones. Fiz. tver. tela 4 no.5:1180-1195 My '62. (MIRA 15:5)

1. Institut poluprovodnikov AN SSSR, Leningrad i Institut fiziki i matematiki AN Litovskoy SSR, Vil'nyus.
(Semiconductors--Magnetic properties)
(Quantum theory)

S/057/62/032/006/019/022
B108/B102

24/640
242120

AUTHORS: Mirlin, D. N., Pikus, G. Ye., and Yur'yev, V. G.

TITLE: Determination of the electron scattering cross section from the electrical conductivity of a slightly ionized gas

PERIODICAL: Zhurnal tekhnicheskoy fiziki, v. 32, no. 6, 1962, 766 - 769

TEXT: A method of determining the scattering cross section of slow electrons from the conductivity of a slightly ionized gas is proposed. For this purpose, the ionized gas has to be in thermodynamic equilibrium. From the voltampere characteristics at low temperature gradients between cathode and anode it is then possible to determine the electrical conductivity and the scattering cross section. The voltage applied must be low enough for the electrons to cause no ionization in the plasma. For concrete conductivity measurements, a special apparatus with plane high-melting electrodes was designed. Measurements with cesium vapor at 1500°K gave an electron scattering cross section of $2 \cdot 10^{-14}$ $cm^2$. There are 3 figures.

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Determination of the electron... S/057/62/032/006/019/022
B108/B102

ASSOCIATION: Institut poluprovodnikov AN SSSR, Leningrad (Institute of Semiconductors AS USSR, Leningrad)

SUBMITTED: April 20, 1961 (initially),
June 13, 1961 (after revision)

Card 2/2

PIKUS, G.Ye.; SKVORTSOV, N.S.; YUR'YEV, V.G.

Measuring electron mobility on the basis of plasma resistance in a magnetic field [with summary in English]. Zhur. eksp. i teor. fiz. 42 no.2:330-337 F '62. (MIRA 15:2)

1. Insitut poluprovodnikov AN SSSR.
(Electons)(Plasma(Ionized gases))(Magnetic fields)

39983
S/181/62/004/008/028/041
B108/B102

24.7000

AUTHORS: Bir, G. L., and Pikus, G. Ye.

TITLE: Band structure and piezoresistance effects in PbTe and PbSe

PERIODICAL: Fizika tverdogo tela, v. 4, no. 8, 1962, 2243 - 2252

TEXT: It has been shown (FTT, v. 4, no. 8, 1962, 2090) that owing to the relatively narrow forbidden band in PbTe and PbSe piezoresistance effects that are due to changes in effective mass contribute much to the constant of elastic resistance. In such a case direct optical electron transitions will occur. It is, therefore, possible to calculate the absorption coefficient if the effective masses of electrons and holes are known. The magnitude of the absorption coefficient is then dependent on the kind of band structure. Theory and experimental data together showed that in PbSe the extrema of both bands are at the point $\Gamma$. One of the bands emerges from the spin-orbital splitting of the triply degenerate band. In PbTe above 77°K only extrema at the point L (on the (111) axis) play an important part in both bands. The conduction band is simple, the valency band is split up owing to spin-orbital interaction. The splitting is 0.3 - 0.6 ev.

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Band structure and piezoresistance... S/181/62/004/008/028/041
B108/B102

There are 3 tables.

ASSOCIATION: Institut poluprovodnikov AN SSSR Leningrad (Institute of Semiconductors AS USSR Leningrad)

SUBMITTED: April 18, 1962

Card 2/2

AUTHORS: [illegible]

TITLE: Piezo-resistance [illegible]

PERIODICAL: Fizika tverdogo tela, v. [illegible]

TEXT: "Bulk" piezo-resistance [illegible] of temperature arise from changes of the effective carrier masses, [illegible] deformation potential constants, and [illegible] elastic constants, as well as from changes in the geometric configuration of the specimen. [illegible] Schrödinger equation for the wave function $\psi_{nk} = u_{nk} e^{i\vec{k}\vec{r}}$ which takes account of the spin [illegible]

$$E_r(\mathbf{k}, \varepsilon) = E_r + E_r(\mathbf{k}_0) + D_{rr} + [illegible] + \sum [illegible] \frac{S_{rn}}{E_r - E_n} + \sum_n [illegible]$$

$$+ \sum_{n,m} \frac{S_{rn}S_{nm}D_{mr} + S_{rn}D_{nm}S_{mr} + D_{rn}S_{nm}S_{mr}}{(E_r - E_n)(E_r - E_m)} - D_{rr} \sum_n \frac{S_{rn}S_{nr}}{(E_r - E_n)^2}$$

Card 1/4

Piezo resistance effects in ... [illegible]

is obtained for the carrier [illegible] the effective mass and the constants [illegible] this case $k_{mn}$ = [illegible] of the two [illegible] can be written for [illegible]. Only the [illegible] zones are [illegible] the simplest case both zones [illegible] not degenerate, as [illegible] the ellipsoids the following expression holds for each zone:

$$E_s = \frac{\hbar^2}{2} \sum_i \frac{k_i^2}{m^*_{ii}} \left[ 1 - \left( 1 + \frac{m^*_{ii}}{m} \right) \frac{\Delta E_s}{E_s} \right] + C [illegible]$$

If, in crystals with face-centered [illegible] the [illegible] zones are in the center of the [illegible], then

$$\frac{\Delta\sigma_{ij}}{\sigma_{ij}} = -\frac{3}{2} \frac{\Delta m^*_s}{m^*_{ij}} + \frac{\Delta\left(\frac{1}{m^*_{ij}}\right)}{\frac{1}{m^*}}, \qquad [illegible]$$

Card 2/4

[illegible] resistance effects in ... [illegible]

The [illegible] effective [illegible] [illegible] $= [illegible]$ [illegible] and $m_{\parallel}^{*}$ are the [illegible] of the [illegible] in the [illegible] deformed crystal. If the [illegible] has the components $C'$, [illegible] in the [illegible] axes, then

$$\Delta [illegible] = - [illegible]^{2}\, \Delta C + [illegible]\, C'' ,$$
$$\Delta [illegible] = - [illegible]^{2}\, \Delta C + [illegible]\, C''$$

are the conductivity [illegible] in these axes. If the extrema [illegible] are not in the center of the Brillouin zone, then

$$\Delta \sigma_{ij} = \sum_{r} u_{ij}^{(r)} \Delta n^{(r)} + \frac{n}{r} \sum_{r} \Delta u_{ij}^{(r)}$$

where $n^{(r)}$ is the number of carriers at a given extremum and [illegible] the corresponding components; $n'$ is the total carrier concentration and $r$ [illegible]

Card 3/4

Magneto resistance effects in ... [illegible]

is the number of the [illegible]. If the [illegible] X points, or in an L point, then the [illegible] are [illegible] when the spin-orbit interaction is taken into account. [illegible] zones may arise from splitting of a degenerate state. [illegible] 5 figures and 6 tables.

ASSOCIATION: Institut [illegible] Semiconductors AN SSSR, Leningrad [illegible]

SUBMITTED: March 1[illegible], 19[illegible]

Card 2/2

MIRLIN, D.N.; PIKUS, G.Ye.; YUR'YEV, V.G.

Determination of electron scattering cross sections based on the electroconductivity of a weakly ionized gas. Zhur. tekh. fiz. 32 no.6:766-769 Je '62. (MIRA 15:8)

1. Institut poluprovodnikov AN SSSR, Leningrad.
(Electrons—Scattering)
(Plasma (Ionized gases)—Electric properties)

44127

S/181/62/004/010/008/063
B108/B186

AUTHORS: Normantas, E., and Pikus, G. Ye.

TITLE: Thermomagnetic effects in semiconductors with degenerate bands

PERIODICAL: Fizika tverdogo tela, v. 4, no. 10, 1962, 2692-2707

TEXT: The thermomagnetic coefficients in p-type semiconductors with degenerate bands are calculated on the basis of the exact theory of carrier scattering (G. L. Bir, G. Ye. Pikus. FTT, 2, 2287, 1960). In this way it is possible to consider band-to-band transitions and their effect upon entrainment and relaxation processes. For easier calculation the isoenergetic surfaces of light and heavy holes are approximated by certain median spheres, the constants b and d of the deformation potential are replaced by their mean values, and the crystal is assumed to be elastically isotropic with the constant $c_{44}$. Scattering of phonons from holes is taken to be negligible. Results: the thermo-e. m. f. $\alpha$, the Nernst-Ettinghausen coefficient Q, and the change of the thermo-e. m. f., $\Delta\alpha_H$, in a magnetic field consist of two parts, one of which is due only to

Card 1/5

interaction of the carriers with the equilibrium phonons (superscript p) and the other only to the entrainment (superscript ph). The hole parts of the coefficients have the form

$$\alpha^{p} = \frac{k_0}{e}\left(2 - \frac{\mu}{k_0 T}\right), \tag{7}$$

$$Q^{p} = -\frac{3\pi}{16}\frac{k_0 u_2}{ec}\frac{1}{1 + \gamma^3 \frac{\tau_{11}}{\tau_{12}}}\frac{L^{(1)}A^{(1)} - L^{(2)}A^{(2)}}{\left\{[A^{(2)}]^2 + \frac{\pi}{4}\beta_2 [A^{(1)}]^2\right\}}, \tag{8}$$

$$\Delta\alpha^{p}_{H} = \frac{k_0}{e}\left\{\frac{1}{2}\frac{L^{(1)}A^{(2)} + \frac{\pi}{4}\beta_2 L^{(2)}A^{(1)}}{\left\{[A^{(2)}]^2 + \frac{\pi}{4}\beta_2 [A^{(1)}]^2\right\}} - 2\right\}. \tag{9}$$

The subscripts 1 and 2 refer to light and heavy holes, respectively. The parts of the coefficients due to longitudinal phonons are

$$\alpha^{ph(L)} = \frac{\sqrt{\pi}}{2}\frac{G^{(L)}}{G_0}\frac{C_1^0}{eT}, \qquad (16)$$

$$Q^{ph(L)} = -\frac{C_1^0}{eT}\frac{1}{H}\frac{A^{(2)}B^{(N)} - \frac{\pi}{4}\beta_2 A^{(1)}B^{(T)}}{\sqrt{\beta_2}\left\{[A^{(2)}]^2 + \frac{\pi}{4}\beta_2[A^{(1)}]^2\right\}}, \qquad (17)$$

$$\frac{\Delta\alpha_H^{ph(L)}}{\alpha^{ph(L)}} = \frac{G_0}{G^{(L)}}\frac{B^{(N)}A^{(1)} + B^{(T)}A^{(2)}}{\left\{[A^{(2)}]^2 + \frac{\pi}{4}\beta_2[A^{(1)}]^2\right\}} - 1, \qquad (18),$$

and the total phonon parts are

Thermomagnetic effects in ... S/181/62/004/010/008/063
B108/B186

$$\alpha^{ph} = \alpha^{ph(L)}\left(1 + \frac{a_2}{a_1}\zeta \cdot \frac{2}{\sqrt{\pi}}\right), \qquad (25)$$

$$Q^{ph} = Q^{ph(L)}\left(1 + \frac{a_2}{a_1}\zeta\Lambda(H)\right), \qquad (26)$$

$$\Delta\alpha_H^{ph} = \Delta\alpha_H^{ph(L)}\left(1 + \frac{a_2}{a_1}\zeta\Sigma(H)\right). \qquad (27)$$

The quantities β, A, L, G, and B involve the relaxation times $\tau_{11}$ and $\tau_{22}$ as well as $\tau_{12}$. $\Lambda$ and $\Sigma$ are complicated functions of H. The entrainment due to transverse phonons plays a minor role and can therefore be neglected in making comparisons with experimental data (C. Herring. Phys. Rev., 95, 954, 1954). There are 8 figures.

Card 4/5

Thermomagnetic effects in ... S/181/62/004/010/008/063
B108/B186

ASSOCIATION: Institut poluprovodnikov AN SSSR Leningrad (Institute of Semiconductors AS USSR, Leningrad); Institut fiziki i matematiki AN Litovskoy SSR, Vil'nyus (Institute of Physics and Mathematics AS Litovskaya SSR, Vil'nyus)

SUBMITTED: April 28, 1962

PIKUS, G.Ye.; BIR, G.L.

Effects of piezoresistance in PbS-PbTe type crystals.
Fiz. tver. tela 4 no.8:2090-2108 Ag '62. (MIRA 15:11)

1. Institut poluprovodnikov AN SSSR, Leningrad.
(Piezoelectricity) (Semiconductors)

BIR, G.L.; PIKUS, G.Ye.

Band structure and piezoresistance effects in PbTe and PbSe. Fiz. tver. tela 4 no.8:2243-2252 Ag '62. (MIRA 15:11)

1. Institut poluprovodnikov AN SSSR, Leningrad.
(Piezoelectricity) (Lead telluride)
(Lead selenide)

ANSEL'M, Andrey Ivanovich; PIKUS, G.Ye., red.; LUK'YANOV, A.A., tekhn. red.

[Introduction to the theory of semiconductors]Vvedenie v teoriiu poluprovodnikov. Moskva, Fizmatgiz, 1962. 418 p. (MIRA 16:2)
(Semiconductors)

NORMANTAS, E.; PIKUS, G.Ye.

Thermomagnetic effects in semiconductors with degenerate bands. Fiz.tver.tela 4 no.10:2692-2707 O '62. (MIRA 15:12)

1. Institut poluprovodnikov AN SSSR, Leningrad i Institut fiziki i matematiki AN Litovskoy SSR, Vil'nyus.
(Thermomagnetism) (Semiconductors)